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ington, Panama, and Valparaiso, 4 h. 16 m. 48.24 s., showing a discrepancy of only 0.18 s.

These measurements have, with the exception of those joining Greenwich and Washington (made by the U. S. coast-survey) and those joining Valparaiso and Buenos Aires (made by Dr. B. A. Gould), been made by officers of the U. S. navy, and are homogeneous, each determination being the result of repeated comparisons through a telegraphic line of time-pieces whose errors on local time were ascertained on the same night by careful transit observations.

It will, of course, be understood that the remarkably small discrepancy (0.18 s.) by which this great polygon fails to close is the algebraic sum of all the errors affecting the various longitudes; but its very small amount is an indication of the care and painstaking of the officers whose labors have given this result, as well as of the accuracy of the instruments and methods employed.

In addition to his valuable work between Panama and Valparaiso, Lieut.-Commander Davis has recently determined telegraphically the longitude of Vera Cruz by measuring from Galveston, and has, on the west coast of Central America, furnished the Guatemalan boundary commission with a starting-point by fixing from Panama the longitude of Guatemala City (in co-operation with Mr. Miles Rock). A detailed report of the work of Lieut.-Commander Davis will shortly be published by the U. S. navy department.

THE KILIMANJARO EXPEDITION.

At a meeting of the Royal geographical society, Jan. 26, Mr. H. H. Johnston gave a description of his visit to Kilimanjaro, on the slopes of which he spent more than five months in the summer and autumn of last year.

Giving a lively and picturesque narrative of his adventures during his stay with Mandara, chief of Moshi, a person of remarkable character, who rules a small tract on the lower slopes of Kilimanjaro at an altitude of about 6,000 feet, and is at war with all the surrounding potentates, Mr. Johnston told how, after some difficulties, he began the ascent of the mountain with forty carriers and some guides, provided by another chief, Maranga. As a good place for settlement close to water, and not too high up, so that his shivering followers might not suffer unreasonably from cold, he selected a grassy knoll, rising above the river of Kilema, which takes its source near the base of Kimawenzi. The altitude of this spot was nearly 10,000 feet. Having seen every one

carefully installed and protected from the—to them—severe cold (for the thermometer descended every night to one or two degrees below freezing-point), he transferred his own quarters to a higher elevation, and began industriously to collect.

His first excursion was to the base of Kimawenzi. The terrible hurricane of wind, however, that raged round this jagged series of lava-peaks, prevented him from continuing the ascent, although he doubted if it were possible for any one to reach the summit, owing to the want of foothold. The snow varied very much in quantity on Kimawenzi. Sometimes the whole peak would be covered down to the parent ridge, with only the precipitous rocks peeping blackly through the mantle of white. At other periods the snow would be reduced to an insignificant patch, and the reddish sand which filled the crevices and glissades between the lava-rocks would be left exposed to view. This change from an almost complete snow-cap to nearly no snow at all might be effected in twelve hours.

His great object, however, was to reach the snows, and, if possible, the summit of Kibô. To do this it would be necessary to sleep on the way. He had, therefore, to induce a few followers to accompany him to carry impedimenta. Starting at 9, he walked upwards, with few stoppages, until 1.30. At first they crossed grassy undulating hillocks, the road being fairly easy. Then they entered a heathy tract, scorched and burnt with recent bush-fires; but higher up, where the blaze had not reached, the vegetation was fairly abundant and green. Small pink gladioli studded the ground in numbers. At an altitude of nearly 13,000 feet, bees and wasps were still to be seen, and bright little sun-birds darted from bush to bush, gleaning their repast of honey. A little higher they found warm springs, the thermometer showing the temperature of the trickling mud to be 91° F. Mounting high above the rivulet, the scenery became much harsher. Vegetation only grew in dwarfed patches as they passed the altitude of 13,000 feet, and the ground was covered with boulders more or less big, apparently lying in utter confusion, and without any definite direction. They were not very difficult to climb over, and even seemed to act as irregular stone steps upwards. In their interstices, heaths of the size of large shrubs grew with a certain luxuriance. About 13,700 feet, he saw the last resident bird, apparently a kind of stonechat. It went in little cheery flocks, and showed such absence of fear, that he had to walk away from it before shooting, to avoid shattering his specimen. After this, with the exception of an occasional great high-soaring kite or great-billed raven, he saw no other bird. On reaching a height a little above 14,000 feet, he stopped again to boil the thermometer and refresh himself with a little lunch. Throughout this ascent, which was easy to climb, he suffered absolutely nothing from want of breath, or mountain sickness; although his three Zanzibari followers lagged behind, panting and exhausted, and complained much of their lungs and head.

“Mounting up a few hundred feet higher than the

last stopping-place," Mr. Johnston said, "and rounding an unsuspected and deep ravine, I arrived close to the base of a small peak, which had been a continual and useful point to aim at during the whole journey from my station. I was now on the central connecting ridge of Kilimanjaro, and could see a little on both sides, though the misty state of the atmosphere prevented my getting any good view of the country. This ridge, which from below looks so simple and straight, is in reality dotted with several small monticules, and cut up into many minor ridges, the general direction of which is, on the southern side, from north-east to south-west. To the eastward I could see the greater part of Kimawenzi rising grandly with its jagged peaks and smooth glissades of golden sand. Westward I still looked vainly in the piled-up clouds; for the monarch of the chain still remained obstinately hidden, and I was at a loss as to how best to approach his awful crown of snow. At length, and it was so sudden and so fleeting that I had no time to fully take in the majesty of the snowy dome of Kibô, the clouds parted, and I looked on a blaze of snow so blinding white under the brief flicker of sunlight, that I could see little detail. Since sunrise that morning I had caught no glimpse of Kibô, and now it was suddenly presented to me with unusual and startling nearness. But before I could get out my sketch-book, and sharpen my chalk pencil, the clouds had once more hidden every thing; indeed, had enclosed me in a kind of London fog, very depressing in character, for the decrease in light was rather alarming to one who felt himself alone and cut off at a point nearly as high as the summit of Mont Blanc. However, knowing now the direction of my goal, I rose from the clammy stones, and, clutching up my sketch-book with benumbed hands, began once more to ascend westwards. Seeing but a few yards in front of me, choked with mist, I made but slow progress; nevertheless, I continually mounted along a gently sloping hummocky ridge, where the spaces in between the masses of rock were filled with fine yellowish sand. There were also fragments of stone strewn about, and some of these I put into my knapsack. The slabs of rock were so slippery with the drizzling mist, that I very often nearly lost my footing, and I thought with a shudder what a sprained ankle would mean here. However, though reflection told me it would be better to return to my followers, and recommence the climb to-morrow, I still struggled on with stupid persistency; and at length, after a rather steeper ascent than usual up the now smoother and sharper ridge, I suddenly encountered snow lying at my very feet, and nearly plunged headlong into a great rift filled with snow that here seemed to cut across the ridge and interrupt it. The dense mist cleared a little in a partial manner, and I then saw to my left the black rock sloping gently to an awful gulf of snow so vast and deep that its limits were concealed by fog. Above me a line of snow was just discernible, and altogether the prospect was such a gloomy one, with its all-surrounding curtain of sombre cloud, and its uninhabited wastes of

snow and rock, that my heart sank within me at my loneliness. Nevertheless, I thought, 'only a little farther, and perhaps I may ascend above the clouds, and stand gazing down into the crater of Kilimanjaro from its snowy rim.' So, turning momentarily northwards, I rounded the rift of snow, and once more dragged myself, now breathless and panting, and with aching limbs, along the slippery ridge of bare rock which went ever mounting upwards. I continued this for nearly an hour, and then dropped exhausted on the ground, overcome with what I suppose was an ordinary attack of mountain sickness. I was miserably cold, the driving mist having wetted me to the skin. Yet the temperature recorded here was above freezing-point, being 35° F. I boiled my thermometer, and the agreeable warmth of the spirit-lamp put life into my benumbed hands. The mercury rose to 183.8°. This observation, when properly computed, and with the correction added for the temperature of the intermediate air, gives a height of 16,315 feet as the highest point I attained on Kilimanjaro. I thus came within a little more than 2,000 feet of the summit, which is usually estimated to reach an altitude of 18,800 feet."

He made other ascents during the month he was in high altitudes. The footprints and other traces of buffaloes were seen up to 14,000 feet; but he never caught sight of one of the creatures, nor did he see any of the big antelope, which also wander up to the snow-line. At a height of 13,000 feet he saw three elephants, and at night the shrill trumpeting of these animals could be heard round the station.

On Oct. 18 he found himself, most unwillingly, obliged to leave the elevated settlement and return to Taveita. The relatively great cold they had experienced had reacted very unfavorably on his men's health, and he feared that a longer delay might render them quite unfitted to carry burdens. He intended, however, to make his return journey entirely through a new and hitherto untraversed country, and this project somewhat consoled him for leaving the summit of Kilimanjaro still unconquered.

Their downward journey, part of the way through trackless bush and dense dank forest, was not without adventure and some reward in scenery of great beauty. The average elevation of this country was between 8,000 and 7,000 feet, and the temperature consequently almost cool, ranging from 43° at night to 70° in the mid-day warmth. After some four hours' walking from their camp, they crossed the long ridge that marked the southern flank of Kimawenzi, and began to descend the eastern slope of the mountain. Soon they emerged on a kind of heath-like country, and then looked forth on a splendid view stretching from Mwika to the mountains of Bura and Ukambani (the Kiulu range), with Jipe on one hand and the river Tzavo on the other. After some enjoyable excursions from his settlement at Taveita, finding that his funds would not support the expedition beyond the end of November, he made a rapid journey to the coast by way of Pare, Usambara, and the Rufu River to Pangani. At Zanzibar, finding there were no fresh funds to enable

him to return to Kilimanjaro, he paid off the last of his faithful followers, many of whom had accompanied Thomson on his great journey, and took his passage on the British India steamer to Suez in quite a sulky frame of mind, as sorry to leave his beautiful mountain as many people are to quit England. Travelling overland from Suez, he arrived in London not much more than six weeks after he had caught his last glimpse of the snows of Kilimanjaro.

PROPOSED EXPLORATIONS IN ALASKA.

SEVERAL expeditions to Alaska are projected during the coming season. Gen. Miles, commanding the military district of which the territory forms a part, desires to acquire a knowledge of the unexplored region between the head of Cook's Inlet and the Tananah watershed. The course of the Tananah is likewise unmapped, except from hearsay, though often traversed by traders in the last fifteen years; so that the opportunity exists here for a fruitful expedition. It is hoped that arrangements may be practicable by which Lieut. Ray, well known for his successful direction of the Point-Barrow party, may be able to command such an exploration. The plan contemplates work either from the Yukon as a base, with a steam-launch and a small party, ascending in June and July, and returning before navigation closes, or an expedition by way of Cook's Inlet, making the portage to the Tananah, and then descending; but a final decision is not yet reached. The party under Lieut. Abercrombie did not succeed in obtaining native assistance, as expected, and were unable to pass beyond the glacier alleged to obstruct the Copper or Atna River about sixty miles from the sea.

Meanwhile, a party has actually started, under Gen. Miles's orders, Jan. 30, for the Copper River, consisting of Sergeant Robinson and F. W. Ficket, signal-observer U.S.A., and commanded by Lieut. Allen. They intend to go to the mouth of the Atna or Copper River by steamer, and ascend as far as possible on the ice, pushing on by water as soon as the ice breaks up and the freshets are over. They hope to cross the divide from the upper Atna, and descend by one of the Yukon tributaries to the mouth of the latter river, and rejoin civilization at St. Michael's. They may be fortunate enough to make the journey in one season, but are prepared to stay two years. They will add a number of Indians to the party at Sitka, and carry various peace-offerings for the Atna Indians.

Lieut. Stoney of the navy is reported to have a new expedition nearly organized, to continue his investigations of the Kowak River. The plan adopted, so far as yet decided upon, is to take a steam-launch, ascend the river as far as possible, and pursue the explorations to its source, and winter in the region if necessary. It is stated that the party is to be composed of sixteen men, which is dangerously large, considering the limited food-resources of the region,

and might be advantageously diminished by one-half for explorations in the interior. If the party were to pass over the divide, and investigate the course of the Colville, returning *via* Point Barrow next summer, it would accomplish a praiseworthy and much-needed investigation.

THE DOINGS OF ASTRONOMERS.

DIRECTOR HOUGH has continued the work of the Dearborn observatory during 1884 in the same lines as in previous years. Mr. S. W. Burnham has had the use of the great telescope, a refractor of eighteen inches aperture, for observations on double stars; and, in addition to assistance rendered to Professor Hough, he has measured several difficult and interesting binary systems. The observatory has been open on Thursday evenings to members of the Chicago astronomical society, and to astronomical classes from the city high schools; and instruction in theoretical and practical astronomy has been given to the senior class of the Chicago university. The observatory delivers the signals for standard time to the city of Chicago daily.

Professor Hough has employed the great telescope throughout the year, in scientific research, with good results. Thirty-two new double stars were discovered, most of which are difficult objects, and can be observed only when the atmospheric conditions of vision are good. The planet Jupiter has mainly taken his attention, and specially the spots and markings on the disk. The remarkable red spot, first observed in 1878, has maintained its size, shape, and outline, with very slight change, ever since that time. Of late, however, it has experienced a marked change in visibility; which doubtless accounts, in good part, for the statements by other observers with smaller telescopes, that the spot had lost its outline. While from 1879 to 1883 this spot had a retrograde drift in longitude on the surface of the planet, during the past opposition this appears to have nearly ceased. For the rotation period of the planet on its axis, Professor Hough derives 9 h. 55 m. 38.5 s., determined from the mean of six hundred and sixty rotations, and varying only slightly from that for the previous year. The great equatorial belt on the disk of Jupiter is found to be subject to gradual drift in latitude from year to year. Its width has also greatly increased, principally toward the south. A large number of white spots were also observed, of variable visibility, and not absolutely relatively fixed in position. The rate of motion of the envelope in which they are situate, Professor Hough finds to be two hundred and sixty miles per hour, making thus a complete revolution around the planet in about forty-four days and a half. Colored prints of several of the drawings of the planet accompany the report, and are very faithful representations of the salient features of the disk. Delineation with the pencil, however, has been only secondary to the micrometric measurements, of which there are between one and two thousand, fixing with entire precision the positions of the belts, spots, and more important markings.